

1                   39. The combination of claim 21 including a  
2 fuel cell in operating communication with said reaction  
3 chamber, to receive hydrogen therefrom.

4

5

6                   40. The method of converting a hydrocarbon  
7 to industrial gases, that includes:

8                   a) providing a U-shaped flow through  
9 tubular reaction chamber disposed upright within a  
10 combustion chamber, and a catalyst contained within  
11 said reaction chamber for the conversion of said  
12 hydrocarbon to said industrial gases by reaction with  
13 steam; said reaction chamber having an upper portion,  
14 and there being a convection chamber extending about  
15 said upper portion to enhance the transfer of heat from  
16 combustion products in the reaction chamber,

17                  b) providing a radiant burner generally  
18 vertically disposed within the combustion chamber and  
19 having a gas permeable zone that promotes the flameless  
20 combustion of fuel and oxidant supplied to said burner  
21 in order to heat a fiber surface of the burner to  
22 incandescence for radiating heat to the reaction  
23 chamber; said radiant burner configured so that the  
24 angle of radiation is predominantly incident upon the  
25 surface of the tubular reaction chamber,

1                   c)    supplying said hydrocarbon and steam to  
2   the reaction chamber heated by said radiant burner,  
3                   d)    and removing said industrial gases  
4   including hydrogen from the reaction chamber.

5

6

7                  41. The method of claim 40 including  
8   providing a gas conditioning system and fuel cell, and  
9   supplying said hydrogen to said fuel cell.

10

11

12                42. The method of claim 40 wherein said  
13   fiber surface of the burner consists of at least one of  
14   the following:

15                a)    ceramic

16                b)    metal.

17

18

19

20

21

22

23

24

25

26

1                   43. Endothermic catalytic reaction apparatus

2    that includes a combustion chamber, comprising:

3                 a) a straight tubular outer conduit

4    concentrically disposed around an inner conduit to form

5    a reaction chamber containing catalyst in the annular

6    space between the outer conduit wall and the inner

7    conduit wall, for conversion of hydrocarbon to

8    industrial gases by reaction with steam, and an inner

9    conduit defined space for the return flow of reactant

10   gases to an exit means; said tubular reaction chamber

11   having one end that extends into the combustion chamber

12   and an opposite end that extends outside of the

13   combustion chamber, and there being inlet means that is

14   in communication with the annular space and an exit

15   means that is in communication with the inner conduit

16   defined space,

17                 b) and a radiant burner vertically disposed

18   within said combustion chamber and having a gas

19   permeable zone that promotes the flameless combustion

20   of fuel and oxidant supplied to said burner in order to

21   heat the metal fiber surface of the burner to

22   incandescence for radiating heat energy to the reaction

23   chamber.

24

25